THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH/NATIONAL PERSONAL PROTECTIVE TECHNOLOGY LABORATORY (NIOSH/NPPTL) PUBLIC MEETING

Thursday, September 28, 2006

DISCUSS Concept Requirements for Certification of Closed-Circuit Escape Respirators (CCER)

Docket Number NIOSH-005

Commencing at 9:02 a.m. at the Colorado School of Mines, Golden, Colorado.

P R O C E E D I N G S

MR. BOORD: I think if we can begin, I think it is probably two minutes after 9, so I think we should start with our meeting for today.

And just to make sure everybody is in the right room, the purpose or the topic of the meeting today is closed-circuit escape respirator proposed concepts. And right at the beginning, we should say that the concepts that are being presented are for discussion purposes only and do not represent any final determination of policy -- determination or policy of the agency.

So the agenda that we have for today's meeting is as illustrated on the screen, and we are going to really try to stick to the agenda.

My name is Les Boord, and I'm the director for the NIOSH National Personal Protective Technology Laboratory. And as indicated on the agenda, I will be doing the opening discussion and a little review of the history relative to closed-circuit type escape respirators.

And those discussions should take us

through approximately 10:30, or should take us up to a break point, after which we will come back and get into part of the technical discussions concerning concepts relative to closed-circuit escape respirators.

Those discussions should take us roughly through to the lunch break. And then after lunch, we will reconvene with a presentation from Frank Koh from the University of Maryland. And following that presentation, we will have an open period for any further discussion or comments.

As we work our way through the agenda, following each of the topics, we will have a question and comment period as well.

For anyone who wishes to make a comment, we have a microphone located in the center of the room. And we would appreciate if the commenter would go to the microphone, announce who they are, who they represent, and then state whatever the comment is.

Concerning some of the logistics for the meeting today, okay, we have the registration table and sign-in sheets outside, so I assume everybody is registered at this point.

You should note that the meeting is being recorded, so it will be transcribed, and the transcription will be part of the docket that we have for the closed-circuit escape respirators.

Presentations will be in accordance with the agenda. And, as I said, excuse me, we will have a question and answer period following each of the presentations.

Also in the information packet that you received when you registered, there are a few things that I would like to point out.

First of all, certainly the agenda. But there are also copies of all of the presentations that we are going to go over today. So you have access to follow them from the handouts. And those presentations are also located on our website, so you will have the ability to go in and look at them from the website as well.

Also in the packet of information are the contact, the contact -- points of contact for further discussions on any of the concepts, and you will also find a copy of, a draft copy of the proposed concepts that we are going to talk about, the technical concepts.

So the purpose of the meeting today is for us to present concepts for closed-circuit escape respirators. And embodied in those discussions, we will be talking about the use of breathing and metabolic simulators as test devices.

We will be talking about ruggedness and reliability concepts as they apply to closed-circuit escape respirators, talk about safety concepts and requirements and concepts for eye protection, activities relative to post-certification testing, and then a concept for registration of closed-circuit escape respirators once they are deployed.

As I noted, the technical concepts that we will be discussing, you have a copy of those in your information packet, but they are also available for you on our website at the address indicated on the screen.

And before we get into the -- further into the discussions, I think it's worthwhile to go through a brief explanation of the terminology involved, and the terminology specifically relative to closed-circuit escape respirators and self-contained self-rescuers.

And to provide that clarity, if you look at the requirements that we currently have for testing and certifying respirators, they are identified in 42 CFR, Part 84. Subpart H of 42 CFR, Part 84 is the section of the regulation that deals with self-contained breathing apparatus.

And within the heading of self-contained breathing apparatus, we have two different classifications of respirators. The first one are respirators that are used for entry and escape. And the second classification is for escape only.

If you follow that tree down and go to the entry and escape type respirators, you have two different -- principally two different types of technology that are employed. You have open-circuit technologies and closed-circuit technologies.

If you take that over to the escape only respirators, you have the same technologies employed, open-circuit technologies and closed-circuit technologies.

Within the world of closed-circuit escape respirator technologies, we have a special category for mining applications that are the self-contained self-rescuers.

When we talk about the terminologies that you will hear today, CCER is a closed-circuit escape respirator, which is identified in Subpart H of 42 CFR. Self-contained self-rescuers are a subcomponent of that.

So the technical requirements that comprise our discussions are really focussed in this area.

And, again, the purpose of the meeting and the discussions that we are going to have today are the discussions relative to developing concepts for closed-circuit escape respirators which NIOSH is doing in consultation with the Mine Safety and Health Administration.

So we are in the process of developing those proposed -- a proposed rule on the performance and reliability requirements of closed-circuit escape respirators.

The time line that we are looking at, or the immediate time line is as identified here. And we are having two public meetings. The first meeting was held last week, September 19, in Arlington, Virginia, and then obviously we have the meeting today.

The meeting last week was attended by approximately 30 participants, and then today's meeting, we have a total, I think, of about 10 or 11 participants.

What we intend to do is, as a result of the presentations today, as a result of the concept that is posted on our website and any further discussions that we may have, we will maintain an open docket for you to provide written comments concerning any of the discussions and proposed concepts.

And that docket will remain open until

November 1. So at that time, we will then look at what types of comments and go through a process of addressing and reconciling the comments that are submitted to the docket.

I would encourage you to submit in writing to the docket any specific comments or questions or concerns that you have relative to the concepts discussed.

That contact information is on the screen. The docket number is identified and the address to submit the comments to. This information is also part of the -- in the packet, the registration packet that you received today.

So, again, the contact information for the docket, the email address, and phone numbers.

In addition to that, we are interested in having one-on-one discussions with any interested parties. And to arrange for those discussions, you can do that through contact with Tim, Tim Rehak. And his phone number and email are on the screen and also provided in the information packet.

The discussions that we are going to have today are really one of the components of a comprehensive program that NIOSH at the National Personal Protective Technology has relative to closed-circuit escape respirator technologies. And that program provides -- is geared to provide respiratory protection with increased capacity. And we will talk little bit about that with some of our research topics.

It will also aim at reducing the physiological burden of escape type respirators. It's geared towards improving the ruggedness and durability of escape respirators and to also improve the capability and provide for realistic training for those who are required to use closed-circuit self-contained escape respirators.

The NIOSH program has really five major components, and those components are the new technology workshops, evaluations of deployed mine escape respirators, research pertinent to escape respirators -- and we will talk a little bit about that later.

Mine escape respirator training support

that the laboratory is providing. And then finally, the new test and evaluation concepts and requirements that we are talking about today. And I'll speak a little bit about each of these program components.

And the first one that we identify and is quite active within the laboratory is the interest in the quest to find new technologies that are applicable to those types of respirators.

And when we talk about new technologies for closed-circuit escape systems, the initial thought that most people have is new technologies for oxygen generation or new technologies for carbon dioxide removal.

And these are certainly important technologies and play key and major roles in advancing the state of the art in these types of respirators.

But I think that in the world of escape respirators, we can't stop that new technology considerations at those points. We need to be looking at all of the technologies, technologies that are applicable to these types of devices. Carbon monoxide elimination. Technologies for removing CO from the ambient air.

I think we need to be looking for -- at the technologies for the introduction and use of new material for respirator components, new materials for breathing hoses, new materials for mouthpieces, new metal that can be used to build the package for the respirator, foil packs, for instance.

I think new materials technology is a ripe area to improve the state of escape respirators. And materials, also, for housing the chemicals, the superoxide chemicals, oxygen generation chemicals that are used, and also materials that can be used to store and deliver the high pressure gases.

And I think that represents a very good example. Because if you look at the technologies that were available 30 years ago when closed-circuit technologies in escape respirators were first addressed, the primary technologies for storing high pressure gases was a steel cylinder.

Since that time, that technology has

evolved to aluminum cylinders, from aluminum cylinders to aluminum-lined cylinders with a fiberglass overwrap. That technology evolved to aluminum liners with a carbon overwrap.

And today we have now technologies that are plastic-lined pressure vessels with a carbon filament overwrap, which have the obvious advantages of reducing the weight and the ultimate burden that the user needs to carry around.

So I think materials, technologies, and the applications of those new materials to escape respirators is a really ripe area for consideration.

But, again, the quest for technology doesn't stop with materiels. I think we need to be looking at new test technologies.

Again, if you go back 30 years ago when closed-circuit escape respirators were first introduced, there were certain test technologies for monitoring the carbon dioxide levels and the oxygen levels that were used during the test and evaluation process.

Those instrumentation capabilities in test technologies have changed drastically since that time to the point today where we have the capability for continuous monitoring of those parameters.

And also today, we are going to talk quite a bit about the use of metabolic simulators to test and simulate the physiological demands the respirator sees. So the test technologies, I think, are very important to consider.

Technologies as they apply to training methods and training materials.

Today the world of training is interactive, use of computer systems to -- as a means of training. I don't think that we will ever get away from the need for live training to actually put the respirator on and see how it's used, but certainly I think there are technologies that can be used to facilitate training on a continuous basis between those live training sessions.

And then we have technology as it applies the service and maintenance aspects of the respirators, indicators for showing when a respirator exceeds a certain environmental stressor.

I think technology as it applies to the service and maintenance aspects of closed-circuit technologies is also an important area.

So what are we doing to advance the state of the art in those technological areas?

Approximately in April of 2005, the Laboratory entered into a collaborative effort with the National Technology Transfer Center to conduct a series of workshops to look at possibly new technologies as they apply to these types of systems.

Two of those workshops were conducted in 2005, one in June and one in December. And at those workshops, we had presenters from various industries, from various government agencies, and from academia presenting concepts of technologies that may be applicable.

A third workshop was held in July of this past year, and we are in planning stages for a fourth workshop to continue to look at the new technologies.

And, again, our interest and our purpose in doing this is to identify and to facilitate the use of innovative and creative approaches for all aspects of mine escape respiratory protection.

The second component of the Laboratory's program for escape respirators is the long-term field evaluation program, which was initiated more than 20 years ago as part of the U.S. Bureau of Mines.

That program currently looks at laboratory tests to evaluate self-contained self-rescuer performance. And that program certainly needs to continue.

At the laboratory, we are looking at a process to redefine the way that long-term field evaluation program is conducted.

We are looking at the possibilities and the challenges to bring a statistical significance to the evaluations that we perform.

We are also gearing the program, the long-term field evaluation program, to fit into the greater picture of post-certification activities that the Laboratory currently uses for other types of respirators.

What does that mean? That means a rigorous schedule of manufacturer quality site audits where the Laboratory will be performing annual audits for manufacturers of these types of devices.

Also integrating the results of evaluation testing into our certified product investigation process, and continuing on further with even additional product audits that are performed.

That program is being redefined into -- to repackage that information in an annual report so that we have an annual state of the technology for closed-circuit escape respirators.

The next component in the laboratory's program for closed-circuit escape respirators is the research areas and the research topics that we are pursuing.

And the first one I would like to talk a little bit about is what we refer to as a hybrid self-rescuer.

As you might imagine, the hybrid

self-rescuer combines the technologies of self-contained systems with those of filtering systems.

So the respirator operation would include both the self-contained self-rescuer technologies, oxygen supply and CO_2 removal, oxygen supply either through a chemical-based potassium superoxides, through chlorate systems or through compressed gases, and then CO_2 elimination using chemical-based systems.

Filter self-rescuer technology can employ and could employ the traditional technologies of hopcalite for CO removal or to look for new technologies, new CO oxidation catalysts for CO removal could also be a component of that research.

Obviously the advantages in looking at a hybrid system that combines these technologies would be the extended protective capability or capacity for that type of respirator.

So in the beginning I mentioned that our program is geared to increase the capacity, the protective capacity. I think this research topic actually will help us address a potential way to do that.

Some of the challenges that are anticipated in pursuing this research are the challenges of sensing. When should the self-contained portion of the system be used? When should the filtering, carbon monoxide portions of the system be used, and what should that switching mechanism be?

So I think there are some unique challenges to this type of system that are derived from the very basis of combining the two technologies and how those technologies are ultimately used.

The second research topic is what is referred to as a dockable self-rescuer. And the concept behind this research would be to combine a short duration and a long duration self-contained system. The operation could be either chemical-based or compressed gas systems.

The advantages -- the potential advantages to using this dockable concept would be that it would eliminate the need for multiple donnings, complete donnings of a self-contained system to achieve -- to achieve escape so that the user would not have to remove one and put another on.

It would provide that -- could potentially provide that extended capacity by providing a short duration coupled into a longer duration. So it would also potentially allow for a smaller and lighter carry self-contained system.

The challenges -- just as with the hybrid system, the challenges for this type of research are right in the heart of the research itself, the docking operation. How would you accomplish that connection between a short -- or between two systems. Okay? And the ability to do that coupling in a contaminated environment without breaching the breathing circuit, so to do it in an uninterrupted fashion.

And then certainly the questions and the issues of the reliability of the mechanism and the simplicity of the operation.

So we have two research topics that are

being pursued as part of our program.

The first research area, the hybrid research, hybrid self-rescuer, was actually a topic that was generated through one of the earlier workshops that we had through the NTTC approximately a year ago.

In talking about the dockable scheme, a potential schematic for doing that is illustrated on this slide here. The schematic on the left side of the screen would be for a short duration closed-circuit system.

That perhaps is working on a pendulum type of breathing circuit where the user exhales into the system through the oxygen generation CO_2 scrubbing motor for the respirator and into a compliant breathing bag.

And then on inhalation, draws the inhalation breath from the compliant breathing bag through the chemical, or through the part of the system, and back directly into the inhalation side.

So it a pendulum system, in and out through the oxygen and CO_2 systems of the respirator.

The right-hand schematic would illustrate a potential coupling of a larger, let's say, one-hour system into that ten-minute system whereby that breathing circuit was changed from a pendulum system to a loop system where the inhalation -- or exhalation gas would pass through the generator and scrubber into the compliant breathing bag. And then on inhalation would be directed through a separate route onto the inhalation side.

A little additional complexity added by the check valves and directional valves that are required to achieve that, but there are systematic pros and cons to using either a pendulum system or a loop-type breathing system.

So the Laboratory is involved and engaged in advancing the research and research topics for closed-circuit escape respirators.

The fourth element and component to the Laboratory's program is the support and training support that we are providing primarily in collaboration with MSHA.

In that regard, we are working with MSHA to develop -- and we have worked with MSHA in the past to develop training modules on inspection, care, and use of closed-circuit systems.

And we continue to work with MSHA on adjustments and updating those training modules to account for the multiple donning processes that might be encountered.

And we continue to work with MSHA to provide support in the way of materials and expertise in training concepts for live training using self-contained self-rescuers.

So the training element or the training support is one of the key components of our program.

Finally we get to the fifth component of the Laboratory's program. That's the new evaluation concepts. That's reality the heart and purpose of why we are here today, to talk about technological concepts for the closed-circuit escape respirators. That's the topic of our public meeting.

It is interesting to note that this is not a new activity for the Laboratory. We have been engaged in the process of developing and defining concepts for new performance requirements. And we have had previous public meetings to discuss these issues. The last of those meetings was in April of 2003.

Since the time of those public meetings, the Laboratory has been working on a staff level to take the concepts and prepare them for a rule making process for closed-circuit escape respirators.

In view of the incidents and the interest in the closed-circuit technologies in 2006, we made a decision to pull back a little bit from the rule making process and to have a series of public meetings to again address the technical concepts and to create a dialogue with our stakeholders relative to those concepts.

So that is the components of the program that we have for closed-circuit escape respirators currently at the Laboratory.

What I would like to do now is talk a little bit about the history of the program. First of all, any questions on the Laboratory's program the activities that we are doing, or any of the logistics relative to the meeting?

Yes, Mike.

MR. KAY: Good morning. Mike Kay, Ocenco, Incorporated.

Les, I have got a question regarding the 2003 concepts.

The meetings, the 19th meeting, the meeting today, we are discussing CCERs, which is a broad group of mining and nonmining apparatus.

Most CCERs are used in a nonmining environment.

The discussions in 2003 and at this meeting and the last meeting really kind of focused on SCSRs, on the problems experienced with SCSRs in the mining environment.

I'm just wondering why the expansion from a real focused discussion on SCSRs has now expanded to CCERs.

And the point is, I think by having a narrow focus, I think we can do a better job at correcting some of the deficiencies or some of the areas where degradation and performance issues aren't being picked up in the current regulations.

Thank you.

MR. BOORD: A good comment.

And I think that even the previous meetings, when we talked about closed-circuit escape respirators in 2003 -- and maybe it wasn't conveyed as thoroughly as perhaps it should have been -- but even at those discussions, we were talking about that part of Subpart H that applies to closed-circuit escape respirators.

So the process and the direction has always been that total picture. Okay.

There's certainly -- you make a very good point. There's certainly a lot of specific issues and interests relative to the mining sector today, okay, because of all of the experiences of this year.

And hopefully our process and the continued dialogue that we have can highlight those issues and focus on them and address them.

But the concept has always been to look at that total requirement for closed-circuit escape respirators.

And some of these issues, while they may be very specific because of the rigors of the mining industry, I think the deployment issues and the environmental stresses and strains, they are not totally unique to the mining sector.

There are other industries and other applications I think that they do have, you know, similar stressors.

Perhaps the mining is a little -- certainly has special considerations.

Any other questions?

In the world of self-contained self-rescuers, the history for these types of devices really goes back to the pre1981 time frame when filter self-rescuers, which are principally illustrated in the photo here, when filter self-rescuers were the primary device that the miners used.

In the period preceding 1981, the late '70s, the real ground breaking research for applications of closed-circuit technologies to escape respirators was performed.

That research looked at a lot of the issues relative to physiological considerations for oxygen consumption, the CO2 elimination requirements, the relationships, the RQ values between the O2 and CO2 production and how you apply those to designing and developing a closed-circuit system.

That research was conducted primarily at the University of Pennsylvania in the physiology labs with Dr. Eliza Kamon and sponsored by the U.S. Bureau of Mines.

It is also interesting to note that during that period, there were quite a few research endeavors looking to develop closed-circuit systems for escape purposes that were for U.S. Navy applications.

Okay. Those research activities also spread into the same types of applications of the technology for mine escape purposes. So that research was really done prior to 1981.

In 1981, we see the introduction of first generation of self-contained self-rescuers. And those were done by a joint certification, NIOSH/MSHA certification under the existing schedule at the time, which was 30 CFR Part 11, and the MSHA provisions for allowing the use of these devices in mines.

That typical first generation type self-contained self-rescuer is illustrated on the right side of the photo.

So with the introduction of the self-contained technologies to the mining industry and other applications, the long-term field evaluation was a program was established in 1983. It was established that the time by the U.S. Bureau of Mines, and it was geared for testing and evaluating 50 self-contained self-rescuers per year.

In 1989, the technology moved and evolved to what we refer to as the second generation of self-contained self-rescuers.

And, again, when you think about the applications of new technologies, this is again applying those technologies to this type of a device to achieve improvements in the equipment.

And that was done, okay, with a second generation of perhaps smaller and lighter self-contained self-rescuers, that may be typically illustrated by the center device, the device in the center of the photo.

So we had this second generation of equipment being introduced.

In 2001 -- and during that period, also, it's interesting to note that the U.S. Bureau of Mines was kind of transitioned into NIOSH.

In 2001, the National Personal Protective Technology Laboratory was established, and the laboratory is located in Pittsburgh.

And at that time, the long-term field evaluation program established by the U.S. Bureau of Mines and transitioned into NIOSH with the Pittsburgh research laboratory was then again transitioned into the Personal Protective Technology Laboratory.

The reason for that is because it just

fits there because NPPTL is geared for personal protective technologies that holds and is the center for the respirator certification program for NIOSH. So the long-term field evaluation is a good fit for the laboratory.

And at that time, the program expanded to encompass a approximately 200 self-contained self-rescuers. The long-term field evaluation program expanded to 200 self-contained self-rescuers per phase.

In 2003, I mentioned the meetings that we had to discuss concepts for new self-contained self-rescuer, or closed-circuit escape respirator requirements. We talked about the collaboration with the NTTC for workshops to introduce new technologies and the workshops that we have had and the plans to continue those workshops.

And then we have the events of 2006, which I think most people in the room are familiar with. And we have the MSHA emergency temporary standard, the Miner Act. And embodied in all of that is also the requests for proposals for research areas in the two topics that I had already described to you, the dockable self-contained systems and the hybrid self-contained systems.

So in a capsulation here, what are some of the things that have been passed on through this 25-year history of self-contained self-rescuers?

I think obviously escape is a primary survival strategy, when a disaster occurs, to escape from the area, whether it be an mine or whether it be an enclosed structure for a CBRN event.

That escape is a primary survival strategy.

And when we apply that escape strategy to self-contained self-rescuers, the history teaches us that perhaps more than one SCSR or one CCER per miner is needed for escape purposes.

And embodied in that is that one hour that the rescuer is rated for does not mean that one hour would be provided to every user under every situation and that the actual time and protection that the user gets from the system has a lot of variables.

And the variables include the miner and the size of the miner and the age and the physical fitness, the difficulty and the physiological demand that the user is required to perform while using the device, and then also the training and familiarity that the user has with the respirator.

If you look at the current NIOSH MSHA approved self-contained self-rescuers, we have five different units illustrated in the picture.

The one the left is the Ocenco EBA 6.5. The next one moving in is the Draeger Oxy K-Plus. We have the CSE SR100, the MSA Lifesaver 60, and here we have the Ocenco M-20 self-contained self-rescuer.

So today these are the five self-contained self-rescuers that hold a current NIOSH approval, joint NIOSH/MSHA approval.

In looking at the basic components of a self-contained self-rescuer, you have basically the outer case that the rescuer is housed in. You have an oxygen storage system which can either be chemical or compressed gas.

You have the breathing hose which leads from the oxygen system to the user, the user interface. And the user interface typically is the mouth bit at the end of the breathing tube with a nose clip to seal off the nose, and goggles for eye protection. And the compliant breathing bag is also a common component for a closed-circuit system.

And as we have already discussed, the principal of operation for a closed-circuit system can either be chemical based or compressed oxygen.

In the world of chemical based systems, we have the potassium superoxides. We also have chlorate systems that do the oxygen generation, provide the oxygen generation, and we have chemical based systems that can be utilized for the CO2 removal.

The second technology is the compressed oxygen system whereby we utilize the compressed oxygen as the supply of oxygen into the breathing circuit and a separate chemical, typically lithium hydroxide, that is used for CO2 removal.

And within those two principal systems of operation, you have the two schematics that are illustrated on the screen now.

The one on the left is a typical closed-circuit chemical oxygen-based system. And on this type of a system, the user exhales into the breathing circuit. The exhaled breath passes through a chemical bed that can be KO2, or it can be a CO2 scrubber.

Passes through the chemical bed into the compliant chamber, the breathing bag. And then on inhalation, is drawn from the breathing bag into the breathing tube and the mouth bit.

The system that's illustrated here would be a loop system, so the inhalation side, there's a series of the check valves located here. It would be directed through the chemical bed into the compliant system, and, then on inhalation, through a directional valve here into the inhalation side of the breathing circuit.

Typically, the systems will house a relief valve. And the purpose of the relief valve is to vent excess breathing gas that may be in the system due to the production of the oxygen from the chemical source.

On the right-hand side, we have a similar illustration using a compressed oxygen system. And if you look at the front part of this, it is principally the same as the chemical-based system with the exceptions that the exhaled breath is passing through a chemical CO2 scrubber to eliminate the CO2. The oxygen supply is then provided from a compressed gas system to feed oxygen into the breathing loop, and then inhalation is through the directional valve and into the system.

Again, these systems illustrated are what are referred to as a loop system, so you are passing through the scrubber or the generator one time and into the inhalation side, but they can also operate on a pendulum system, which is in the earlier schematic that I showed you where the inhalation and exhalation both pass through the chemical bed.

The work that we have done down through the years with -- in the closed-circuit self-contained systems has really been done in cooperation, in cooperation with our stakeholders that are illustrated here, the PCOA, the NMA, the United Mine Workers Union, the United Steelworkers. The U.S. Navy is an important stakeholder, as well as the various self-contained system respirator manufacturers, CSE, Draeger, MSA, and Ocenco.

And it is also important to note that MSHA, we work very closely with MSHA in all of the areas of closed-circuit technologies, and MSHA is a co-approver with NIOSH for these types of respirators.

The long-term field evaluation program, as I mentioned, that's a program that we have to look at the continued performance of deployed respirators. And that program has a history of, as I said, dating back to 1983.

The illustration that we have here shows what the frequency of that activity has been, beginning with the first publication in 1986 continuing to the current Phase 8 and Phase 9 testing and report preparation.

Some of the experiences that we have had through the years of the long-term field evaluation are depicted in some of these photos. And if we can walk through the photos.

On the upper left-hand corner, we have an illustration that shows the type of mechanical degradation or issues of mechanical integrity of the various components that were comprising the self-contained self-rescuer.

The second photo illustrates some of the issues that were discovered relative to the material characteristics that were utilized in the breathing tubes for these types of systems.

The lower left-hand corner illustrates issues relative to design and retention of the chemical bed within the self-contained self-rescuer. And the lower right-hand illustration is that of the results from chemical deterioration to produce dust, and then dust migrating into the breathing circuit.

So when we look at the first generation of self-contained self-rescuers, these are some of the typical types of issues that were discovered from that program.

When we move on to the second generation of self-contained self-rescuers, we have dealt with issues relative to breathing bag -- or breathing hose materials, issues of the mechanical integrity of the overpack and the abuse that the overpack can be subjected to to actually open it to the point where the ambient atmosphere could migrate into the system.

There are issues relative to chemical testing and migration into the breathing system.

Again, the rugged use and exposures, environmental stressors that the equipment sees in the field is evidenced by a dent in a metal canister.

And then again, just the overall exposure, environmental exposure of this type of equipment to the rigors of the use, environments for use.

Some of the things that have been introduced as a result of these investigations are the nondestructive tests or indicators that are integrated into the self-contained self-rescuers, some of self-contained self-rescuers.

Some of the units employ high temperature indicators to provide the user with an indication if the device has been exposed to a temperature greater than the recommendations of the manufacturer.

There are also devices that are used at the field level and at the laboratory level to determine and evaluate the extent of bed degradation. Some of the earlier photos showed the retention system for chemicals and the issues relative to chemical dusting and migration into the breathing system.

Technologies today utilize test devices that measure the extent of the degradation and make a determination whether the unit is serviceable for use.

Some of the conclusions that can be derived from this long standing program is that the self-contained self-rescuers, to pass their inspection criteria, the inspection criteria that are designed specifically for the device that is being used, should provide for safe life support and that, with all of the systems, there is some performance degradation observed in all of the devices over time from the rigors of the deployment environment.

Again, the long-term field evaluation protocol, the objective of that program is to compare performance of deployed systems to new systems. The method is a method that's characterized by collection and inspection. So we visit the mines. We collect the self-contained self-rescuers. We bring them back into the laboratory.

We replace the ones in the field. We bring them back into the laboratory to perform a laboratory inspection and then perform a test. And the results of that then is a report that's generated summarizing the results of those tests.

The testing that we do in the program is either a testing that utilizes a metabolic simulator and in some discussions human subject testing.

In all cases, the testing is geared at a specific physiological rate, and that rate is an oxygen consumption of about 1.35 liters per minute and a CO_2 production rate of about 1.15, which I believe is about .85 to .9 respiratory quotient, and a ventilation rate of 30 liters per minute and tidal volume of 1.68 and frequency of 17.9.

So the specifics of the simulator testing are identified in the tabulation. A man test is employed. It's geared to generate then to duplicate or to simulate that same oxygen consumption. So typically a user of the device is walking on a treadmill at a rate predetermined that will produce an oxygen consumption of about 1.35 liters per minute.

It's interesting to note that that testing that we do, the metabolic simulator testing and the man testing that's done as part of the long-term field evaluation is not the same as the test that is used to certify the equipment.

In 42 CFR, Man Test No. 4 is the basis for establishing the duration or capacity of a closed-circuit system.

That Man Test No. 4 is comprised of several different activities which can include walking or running on a treadmill, carrying a weight over an obstruction, an overcast, pulling weights, and various activities that are used during the course of the test.

This complicated graph that we have here illustrates what the physiological CO2 -- oxygen demand and CO2 parameters for a user doing a Man Test No. 4 may be.

And I know it is really difficult to see, but you have this one -- this is one of the handouts, it is part of the handouts in the folder.

And basically, I think some of the key issues -- if you look along the axis here, you have either the oxygen percentage, the oxygen consumption from zero to three liters per minute, or it can also illustrate the CO2.

When you look at it, the yellow part of the graph is the CO2 elimination requirements, our production requirements, and the green or the dark part of it is the oxygen demand, the O2 requirements for the user.

And as you go along X axis for the graph, it's time dependent. And at various times, it shows what the activity involved in Man Test No. 4 that is being performed.

So if you look at some of the details here, you can see that when a Man Test No. 4 is started, it's actually started with a sample period.

So the technology that was established in 30 CFR and later carried into 42 CFR was that of doing a grab sample.

So when the user starts to use the piece of equipment, the first part of the activity is to do a sample, and the person is standing still when what happens.

Typically that is associated with a sedentary type condition. Oxygen consumption rates may vary between .35 and .5 liters per minute. So you can see it has a pretty low demand more.

And from there we can go into some of the more aggressive activities defined in 42 CFR, or in Man Test No. 4. You get to the activity that's climbing on a ladder at a certain speed while wearing the respirator.

We can see that the oxygen, the 02 requirement actually peaks up to about 2.7 liters per minute.

So you can follow that trend and see that it is -- that the oxygen requirements are kind of demand responsive depending on the activity that's being performed.

In the long-term field evaluation program, as I mentioned, we are testing the equipment at a constant rate. And that constant rate is 1.35 liters per minute oxygen consumption. That's illustrated by this yellow constant line on the curve.

So that gives you some relative comparison between what we currently do in the long-term field evaluation and the Man Test No. 4 data, parameters, which are used to certify the equipment.

Again, the purpose of the long-term field evaluation is to obtain data to compare performance of deployed to new systems. Those evaluations are based on the experimental protocols, not the certification testing, the man tests that are in 42

CFR.

Test methods and protocols, results cannot be substituted for 42 CFR. The long-term field evaluation is a different type of testing regimen.

The process for long-term field evaluation is process of discovery. The collection of the respirators from the field is not based on a random sample, so therefore some unique issues and problems relative to how those respirators are collected.

The process discovers problems and can identify existing problems that may have not been anticipated by the standard and then integrate those into continuous improvement for the systems.

So practical and prudence incorporated, the indicators that we mentioned a little while ago were one of the by-products of that.

I think it is important to note, though, that the results of any testing do not predict a successful use by anyone in an escape situation.

Reliability issues. Reliability issues concerning the self-contained self-rescuer is will the device work. And that's by-product of how has it been handled.

Have the required inspections and conditions for continued use of it been complied with.

As I showed with some of the earlier pictures, some of the exposures and abuse that the systems see can be pretty extensive. How old is the system? Typically the self-contained self-rescuers have a time line, an expiration date.

Okay. Criteria for when should the SCSR be removed from service and are the inspection criteria the right criteria and are the people that are doing those inspection criteria properly trained in how to perform the inspections and then how to interpret the results.

So some the actions that we think can be derived from the long-term field evaluation are the inspection of all field deployed self-contained self-rescuers, to remove the systems that don't conform with the inspection requirements from service.

We feel that there is a real benefit to a program for voluntary registration, and we will talk a little more about that in the technical discussions.

Training. Training cannot be overemphasized. I think that the training to pull in new technologies for training users on how to use this type of equipment, training in the techniques for multiple donnings of the equipment and live training, actually putting the piece of equipment on and experiencing what it is like to do a series of exercises and activities while wearing the respirator.

Training is a very important role in the successful use of self-contained self- -- of any respirator, and especially for self-contained closed-circuit systems.

And as I already mentioned, the program at the laboratory is to expand the long-term field evaluation program, to integrate that program into the other components of auditing for certified products, our certified product investigation program, which is an acronym is the CPIP program, the frequency of manufacturer and site audits, and then to have that program produce timely outputs on an annual basis summarizing what the results have been, and to also pull a statistical significance to the results and the evaluations that are observed.

That concludes our little brief discussion on the history and background of SCSRs.

Before we get into the next part, are there any questions or comments relative to any of that?

Mike?

MR. KAY: I have got a question.

MR. BOORD: Sure.

MR. KAY: Mike Kay, Ocenco.

Do you anticipate the Phase 8 and Phase 9 field evaluations to be released prior to the November 1 deadline of the docket being closed?

MR. BOORD: Yes.

MR. KAY: So we will have time to review and comment on the docket?

MR. BOORD: Yeah.

MR. KAY: Thank you.

Follow-up question. If the release is delayed past November 1, will the November 1 be extended?

MR. BOORD: That's a good point.

I think we would certainly be agreeable to doing that.

Okay. What we won't want to do is we really do want to encourage feedback and input on the concepts that are we discussing. And if timing is an issue, then the November date would be moved.

MR. KAY: Thank you.

MR. BOORD: Any other questions?

I think what we will do now, we are a little bit ahead of schedule, but I think rather than break up the technical discussion, which I think we did last week and perhaps lost a little continuity, why don't we take a 15-minute break, and we will meet back, let's say -- it's 10 -- a couple of minutes after 10. Let's say 10:20 we will resume.

Okay. Thank you.

(A recess was taken.)

MR. REHAK: Okay. If everyone would be seated, we will start up again.

Good morning. My name is Tim Rehak, and I'm also with the National Personal Protective Technology Laboratory. And along with Bob Stein, we are going to go over and review our proposed concepts for the certification standards of closed-circuit escape respirators.

And as Les stated earlier, I need to repeat it again, these concepts are being presented for discussion purposes only and do not represent any final determination or policy of the agency.

Okay. While the new standards will be a separate subpart under 42 CFR Part 84, some of the existing subparts still apply and will apply to these new standards.

They include subparts A through E in their entirety covering everything from general provision to quality control.

Along with the entire Subpart G, which covers general construction and performance requirements.

And also paragraphs 50, 51, and 52 of Subpart F which covers scope of approval, atmospheric hazards, and service time.

Briefly, in the handouts, you have our concept paper on the new certification standards, and it is also listed on NPPTL's website.

And this is each of the sections that are covered by the new concepts. And the areas I would like to point out are the highlighted areas where we feel there are the major differences between the existing certifications and the new standards or the new proposed concept standards.

And they are capacity tests, where we will be rating on capacity of volume of oxygen in lieu of duration; performance tests, where we will be testing under various work rates; environmental treatments will be mandated now in our proposed standards; post certification testing will also be mandatory; and we are looking for voluntary registration.

We will cover these more in detail. Next

Bob will come up and start going through some of the sections.

Bob.

MR. STEIN: Thank you, Tim.

My name is Bob Stein. I'm an engineer at NPPTL and pleased to have this opportunity to present these technical concepts for closed-circuit escape respirators.

The information is also available on the website, but we will have this overview today that might generate some questions or discussions as we move through this.

We just need to hit again a little bit on this slide that you saw earlier, talking about how this will fit into the overall certification regulations or approval regulations for respirators.

Currently closed-circuit escape respirators are approved. The technical requirements are contained within Subpart H. This covers all types of self-contained breathing apparatus, both closed-circuit, open-circuit, as well as escape and entry.

And the newly proposed standard, if you will, what will be -- what will occur as a result of this is that those technical requirements for closed-circuit escape respirators will be brought out into their own subpart, and this will be highlighted in this graphic by this block down here in the lower right-hand corner.

From a terminology standpoint, it is just pointed out here that SCSRs are a type, or would be covered under closed-circuit escape respirators for the most part. Now, the way we know them, they are covered in that section.

Any kind of improvement to the technical requirements for any of these respirators takes a lot of developmental work.

There has been a lot of research done leading up to this point. The long-term field evaluation gives invaluable experience in how you might change the standard, how you might bring about improvements at the time of certification that would have some bearing.

Much is learned by looking at respirators that have been deployed under actual use conditions for some period of time and evaluating them.

This is part of the certification process in a sense because it has some bearing on how it's tested at the time of approval, how is it going to perform in the field. And our experience in certification testing also gives rise to some of these improvements.

And also the certified product investigation process or program gives a lot of information for these, anything that's learned through long-term field evaluation, through certification testing. If there are issues as an investigation is conducted, all of those details that might lead to improvements in the standard are revealed in some sense.

And when you have the opportunity go back over all of this information and make some coherent sense of it, you can make improvements to the technical requirements for closed-circuit escape respirators, in this case.

Or if you had that kind of information

available for other ones, for those as well.

This is a performance-based standard, as it is proposed. And we want to emphasize that it is performance based. However, even in the existing standard, some attributes, if you will, or some components are called out.

The systems, as we know them, we are familiar with them. But we realize that with a new standard, we might see new technology. One would hope you would see different technology.

And as these things come in, if it varies too far afield, it might not have the same kind of -- or the standard might not have the same kind of bearing on it.

And so therefore some components that we call out or would require as it is proposed, one of them being nondestructive testing to reveal any kind of degradation to the unit in the field.

And this only called for in those instances where it would be required.

And that you see an example in this case of a Draeger self-contained self-rescuer with a nondestructive test unit clipped on the back of it. That's the small box with the white face on it, the red and green squares the indicators where the switches are.

And this device, once activated, the unit can be shaken, and an evaluation is made to determine the integrity of the chemical bed, in an instance where that is appropriate.

This is something that would be called for because any time there is chemical used in the unit, degradation of that chemical can change the performance characteristics of it, so we would like to know ahead of time without having to open it up has this occurred and so forth.

Along those same lines, tamper-resistant or tamper-evident casing. These are one-shot devices as we know them. We would expect that new entries coming on after the newly released standard would be the same way.

We would want to know has the unit been tampered with in any way; has it been opened.

It is difficult to know that it will

perform as it is supposed to or as it has been designed to if it has been opened perhaps ahead of time allowing outside atmosphere to get into it or even, in worse events, if it has been opened and somehow tampered with inside.

In both of these situations, we would want the case to be evident and reporting that this has happened.

Eye protection, which is currently included in most of them, is not mandated in the current standard. It is proposed under the concept that this would be -- it would be a necessary inclusion.

You would have to include eye protection as the eyes are an important route of entry for contaminants.

In some cases where the smoke might be so thick, you couldn't see very well. It would still be a problem that the smoke would be irritating to the eyes and just add that much more difficulty in escaping as well as providing that kind of route for contaminants to enter the body.

Attributes. In general, as Tim pointed out in the earlier slide, it still needs to meet the general construction requirements that are established in the existing regulation. And we also want to ensure that it does not constitute any additional hazard in any workplace where it is introduced.

And we will get on into that in a little bit more detail as we go through the slides.

Instructions, again, this is something that is included with the current units, but we want to call out this explicitly in the proposed standard. We want the units to lend themselves in some way to hands-on training.

And service life is another thing that needs to be addressed. It is called out explicitly, that those pertinent facts of service life be revealed to the user.

These would include things such as times that are appropriate for use or deployment in the field and any additional conditions of use, inspection requirements, and so forth.

This is done, but it is not explicitly called out in the regulation currently that it would be a change under the proposed standard.

Now we get down to what is perhaps the biggest departure from existing standards, and this is the concept of using the breathing metabolic simulator to evaluate the life support capacity of the unit.

Closed-circuit breathing apparatus, in order to understand how it works or think about how it works, it really is, once donned, a marriage of user and respirator.

And historically and traditionally, that's how they have been evaluated. It has to be used by a human subject in order to elicit whatever behavior it has been designed to provide, and that behavior assessed, gas concentrations, breathing resistance, temperatures and so forth.

And up until the advent of easily obtainable microcomputers and so forth, something that we could drive a metabolic simulator with, that's the way that was always done.

But with the advent of that kind of technology, we have breathing and metabolic simulators, something that has been brought up before, in order to stand in for the human subject in making a functional assessment of the breathing device.

And this, as proposed, would be used for two different types of tests. One, a capacity test, and the other, a performance test. And the distinction between those two will become more apparent as we get into the greater details on subsequent slides.

However, what should be pointed out is, these would be at very well fixed and established protocols on the breathing and metabolic simulator.

The human subject going through a series of exercises is going to elicit certain types of oxygen consumption rates that are going to feed in a certain amount of carbon dioxide.

The simulator can be programmed to do this at a rate that somewhat mimics a human subject doing the same kinds of tests.

And one of the slides that Les had earlier that showed the graph of a human subject performing Man Test 4, as opposed to the flat line that the breathing and metabolic simulator would do, for something like the capacity test in order to understand how much oxygen is contained within the system and can be delivered to the user, we would be doing a test like this.

And then in order to better establish how the unit might perform when it is subjected to different and varying levels of demand, a performance test.

Throughout the proposed standard, however, human subjects will not be totally left out of the equation. We will still look at using human subject tests for our qualitative evaluations and for wearability.

Anything that we would ask the simulator to do, in one sense of it, we would ask a human subject to do, either by a constant work rate test, walking on a treadmill, or a -- and the performance test would also be mimicked on the treadmill, but at different speeds and perhaps even elevations in order to elicit the kind of work rates that we are looking for.

The device has to work for people. It cannot just work for a simulator.

So throughout the testing, this will be established through testing with human subjects, and we will also be able to evaluate the interface between the unit and the human, have considerations been made for, is the breathing bag well placed, hot surfaces, are they in areas where they might come in contact with the user, these things that are able to be evaluated much more effectively by actually running tests with human subjects.

And that will continue.

Under the heading of general testing conditions, under the concept as proposed, there has to be some established stressor level.

Current human subject tests are evaluated periodically, not throughout the range of work rates and stressors that are imposed upon the unit. And so we have to have some kinds of limitations to use in doing a continuous evaluation of the performance of the device.

So what is proposed?

You see two different columns of numbers. They are both appropriate because one establishes an acceptable range of excursion throughout the different types of exercises, throughout the time duration of use and so forth.

It is proposed that, for instance, the carbon dioxide be maintained at an average concentration of less than or equal to 4 percent. It is proposed that the average inhaled oxygen concentration be maintained to be greater than or equal to 15 percent.

Peak breathing pressures throughout different work rates and ventilation rates, you might see excursions. The limit for the excursions would be expressed as minus 300 millimeters of water gauge all the way up to a positive 200 millimeters of water gauge on exhalation. And temperature excursions over the life of the apparatus limited to less than or equal to 50 degrees C.

These, as we measure them currently with the simulator, are measured as one-minute averages over the duration of any test, and that would be how those numbers would be compared to these acceptable excursion ranges.

It would be one minute averages.

Now, moving on into how the unit needs to perform overall, however, it is not proposed that they -- it would be -- any device would be permitted to hover at those ranges.

Rather, that they would -- these limitations would look something more like the current standard, with average inhaled CO_2 being maintained at less than 1 and a half percent average over the test, that average inhaled oxygen concentration be maintained at least at 19.5 percent greater than that.

Peak breathing pressures, this is expressed as a swing, not to be greater than 200 millimeters of water gauge, and that the temperatures average over the test not to exceed 43 degrees Centigrade.

Capacity test. It had been mentioned earlier about one hour not being one hour for every user under every circumstance. And that's fairly well understood, but it continues to be a point of confusion sometimes when the units are deployed.

It has been proposed that these devices that would be approved under the concept be rated somewhat differently in terms of the capacity, the life sustaining capacity that they have, and that being more or less in the liters of oxygen that they are able to deliver the user.

The test will be continuously monitored different from the current standard, that the tests are proposed will all -- will be able to be performed in one location.

So whether you are doing it with a simulator or with a human subject, you will be able to monitor it continuously. Obviously you can do that with the breathing and metabolic simulator.

Also something that has been added is that there will be breathing and metabolic simulator tests after environmental treatment. So we will be looking at some of the units as they come in in an as-received condition, some of them after they have been exposed to environmental challenges in the lab. And the expectation is that the performance will be the same in both cases.

Also, again to stress that any of the human subject tests that are done on the treadmill will be continuously monitored.

Now, there is one exception to this, and the slide that explains the different capacities comes afterwards. But for right now I just want to point out that the highest rating, the Cap 3 rating, in the case that they would be approved for mining use, there would be an assessment made against the existing Man Test 4 regimen that is established in 42 CFR 84.

Those tables will be still be there. Any other type of self-contained breathing apparatus that is submitted for approval will still be evaluated against the existing technical requirements in Subpart H. And in the case of a co-approval, if the unit is rated at a Cap 3, it's proposed that the Man Test 4 would be done on those to indeed show that the life support capacity is at least equivalent to those that are approved under the existing regulation.

This is an effect of the Mining Act that calls for any kind of new technology that is introduced to be at least as protective as any old technology that was there prior to that. And this is still viewed as a kind of waterline that will establish whether or not that protection is at least as great as what was approved under the old standard.

To get into the capacity test requirements a little bit more deeply, now, you see the table that contains the different ratings that would be established under the new -- or under the newly proposed technical requirements.

We would have -- start off with a Cap 1 device which would contain between 30 and 59 liters of oxygen under what has been proposed.

Now, what you see, however, in the columns that are to the right of that establish that for a lower duration escape activity, which would be able to be sustained by one of the lower capacity devices, human physiology allows for a greater level of activity on average over that shorter time than it would for a longer time span.

So the idea here is that the lower capacity devices, which it would be projected would be used in short duration escape activities, do need to provide oxygen and do need to be able to scrub at a somewhat higher level than those that are designed to allow for a longer duration activity.

This is a physiology limitation, not a limitation of the device, and one where it is proposed this way so that any device approved under this would be able to sustain for the user under the kind of conditions, perhaps, that you might expect in a short duration escape.

That's one of the few parameters where you can say that maybe -- I don't even want to say with some certainty, but that it would be allowed for in that shorter duration escape.

The higher ventilation rate, you see 55, higher respiratory frequency at .2. And this steps right down as we go.

A Cap 2 device would contain between -- roughly between 60 and 80 liters, would have be able to deliver oxygen at an average rate of 2 liters a minute in its capacity test being able to scrub at least 1.8 liters a minute CO2.

Somewhat lower ventilation, somewhat lower respiratory frequency, all the way up to a Cap 3, which must contain or be able to deliver at least 80 liters to the user.

The average work rate in this case being 1.35 liters a minute of oxygen delivered, 1.15 CO2 scrubbed, a Ve of 30, and a respiratory frequency of 18 breaths per minute approximately.

And graphically it looks like what you see below. The Cap 1 device contains this much oxygen, Cap 2, you know, a greater amount, Cap 3 a greater amount yet, a very simple concept.

The performance part of that is probably the most complicated part, and I'm sure there might be questions on that aspect of it.

Now, you say with those averages in mind how could we assure, however, that the longer duration device would still be able to sustain some kind of short burst.

Obviously, any time during an escape, a user might able to sustain a short burst of work at a very high activity level. And so to cover that issue, this is why the performance tests are proposed.

The units would be subjected to variable work rates, still being continuously monitored in an as-received condition, also tested after they have been subjected to environmental treatments and exposures and also, in the as-received condition, repeated by a human subject on a treadmill.

The performance test concept plays out this way.

The unit would be subjected to a high work rate for a short duration of time at the beginning of its life, five minutes at a 3 liter a minute work rate or oxygen uptake, with CO_2 being injected at a rate of 3.2 liters per minute.

The ventilation rate for this part or portion of the test 65, the respiratory frequency 25.

And if you recall during the portion of the presentation made by Les, the graph, again, that expounds on what the work rates look like in Man Test 4. And you saw that range, anywhere from maybe about .5 or .35 liters per minute uptake all the way to nearly 3 liters a minute. These are fairly well representative of population at large in terms of what kinds of maximum work rates they can do.

It's not that you can't find people that can do more than that among perhaps young very fit populations.

You might find some that are able to sustain a higher VO2 than 3 liters a minute. However, the population in general, there are quite a few people that probably can't sustain even the 3 liters a minute.

However, this is a good average. And if the unit can do this, it is going to be able to provide for people demanding that kind of oxygen update for that short duration or burst that might be encountered.

The next segment of the test, expose it to 15 minutes at 2 liters a minute oxygen provision, 1.8 liters a minute CO_2 scrubbing capacity at a ventilation rate of 44 and a respiratory frequency of 20.

So after a short very high or nearly peak work rate, we would step it down to something that is more sustainable by people. And then finally tapering all the way off to a ten-minute run at a half liter minute oxygen supply and a .4 liter a minute CO_2 injection at a respiratory -- or a ventilation rate of 20 and respiratory frequency of 12 breaths per minute.

One reasonable thing or way to think about this is somebody that takes very quickly with an apparatus, realizes they can't sustain that work rate, slows down to something that is still pretty hard, and then finally slows down to the point where they may be walking or standing.

And we don't say that this happens every time, but if it were to happen, does anything untoward happen with the unit. We want to be able to evaluate if the unit is able to adjust to these different respiratory frequencies, different breathing rates, different oxygen supply demands and different scrubbing demands.

If the unit is able to provide a greater quantity of oxygen, this would be cycled again.

Wearability test concept, getting back to the human factor.

We want to ensure that any of the devices can be easily and quickly donned, something that can't be assessed on the simulator. In many of the human subject tests for this purpose, the user would be going through the donning procedure.

We would also want to ensure that during any reasonably anticipated activity, that the CCER will accommodate these things, not to physically harm the user, not to significantly hinder the user, and that it will continue to provide an adequate and uninterrupted supply of breathing gas.

These facets of the performance are

addressed in the current standard, and the series of man tests that are prescribed in Subpart H, we step up to a different range of human activities.

And Man Test 3 includes many of these different postures that the breathing apparatus is subjected to, while being worn by the test subject.

Any of these could be reasonably anticipated by somebody escaping any type of situation, and we again want to ensure that a user that is going to tip the device over isn't going to do something with the device that's going to either cause them to perhaps lose their grip on the mouthpiece, perhaps collapse a breathing bag, anything and many things that we might not even think about when we actually have a human subject wear it and do these, we can see how the apparatus is able to perform.

Is it able to continuously supply breathing gas and not subject the user to any additional physical harm that might be say, perhaps, again, by a hot surface, any of those types things that would be encountered with the breathing apparatus as it is working.

You can, I suppose, well, since you have the handouts, you don't have any difficulty going down through the different activities that are proposed to be used.

Again, this table is what is proposed. And we welcome any comments on activities, additional activities that perhaps would be reasonably suspected during an escape to be able to assure that the interface between the apparatus and the human subject is adequately covered and addressed.

The environmental treatments that we have been talking about. This is, again, lessons learned, research through long-term field through certified product investigations, even through, in some cases, the approval process.

What is proposed is that four units will be tested for capacity and performance after they have been exposed to environmental treatments. What do these environmental treatments consist of? Extreme temperatures, cold soak, a hot soak, physical shock, and being dropped from a height of approximately one meter on each axis. This would be roughly belt height by a user having the unit right in front of them, to fall out of their hands, perhaps. One drop on each axis.

Also vibration, a vibration spectrum that's based along MIL Spec 810. MIL Spec 810 is -- was designed by the Army to look at hauling equipment for equipment used in over-the-road type either trucks or tracked vehicles.

The vibration spectrum that's proposed is akin to the tracked vehicle type, among the more severe of the vibration spectrum.

And, again, we know from experience and research -- and mining probably is one of the most challenging environments. Again, it has been pointed out already, we know that's not the only place they are used. But certainly if they are up to the rigors of the mining environment, they are up to the rigors of most deployment places, at least that we have encountered so far.

Additional testing. Back when the

opportunities were first introduced into mining, the question was proposed about do they pose any additional hazard when you are bringing oxygen into the presence of the fuel rich environment.

That's a reasonable question and one that was actually assessed by running many of the first generation units -- actually, all of them, through these kinds of hazard assessment tests where situations are contrived to with be worse case.

And that would be, for instance, run over by a tracked vehicle, going through a feeder breaker, which is illustrated in this picture. And that kind of orange burst back there is an ignition of an oxygen self-rescuer in a feeder breaker.

It can occur. It has occurred in relatively few numbers of instances that we have had reported back from the field over the years.

With over 20 years of experience, there have been some fires reported. And as it was assessed at that time originally, the fires are not unmanageable. They can be put out easily by the use of water, rock dust. They are short duration. They don't tend to get out of control.

So it's not kind of hazard that might have been imagined. And certainly the experience points out, it's not a common occurrence. It's not as common as one might have thought as these units were first introduced into fuel rich environments.

It's relatively well established through the testing that was done that if the unit stores under 200 liters of oxygen or the storage pressures are no greater than 3,000 PSI, that those hazards fall within the bands or bounds that were described by that original testing.

However, it is understood that with these proposed standards, we may see units that contain more oxygen, that may have higher storage pressures due to new technology in storage containers, any number of reasons. And, again, that is not accepted that these units would fall within the bounds that were established during that original testing.

So as proposed, if we saw units that contained more than 200 liters of oxygen, if they had gaseous oxygen at more than 3,000 pounds per square inch, they would be subjected to same types of hazard evaluations that were done on all of the other units, not as part of the certification procedure, but that is proposed to be brought in as part of the certification procedure.

Eye protection, which it was pointed out, that's one of the attributes that is called out explicitly.

Not only it is called out to be there, but the eye protection, as proposed, would have to meet these types of existing standards for dust and gas under ISO -- existing ISO standards also for durability. And for fogging, an EN standard. This is what has been proposed, and you can see more details of that as you read through it on the web.

Post certification testing is something that's been done historically under the newly proposed standard.

This would, again, become codified or a requirement to test new and deployed apparatus for capacity and performance, that any failure in the performance might result in revocation of approval or other remedial actions as they would be appropriate.

The proposal is that it would continue in much the same vein as it has over the years, that NIOSH would replace deployed units with new ones to obtain those for testing. And since that is the scheme, it would also be necessary that any active approvals would be maintained -- there would be some supply maintained is what I'm trying to say, that we would be able to purchase additional units for the make up so the evaluation could continue for the devices that are in the field.

Now, we are getting down to the last of the concepts that we are going to talk about in detail, and that is that of voluntary registration.

Tim is going to take this part of it.

MR. REHAK: Okay. One of our concepts is, as Bob said, voluntary registration.

The reason why we are putting forth this idea is to provide NIOSH -- and MSHA also would like to have the information -- on how many of the different type of units therefore out in the field and where they are located at.

This will help us, especially in sampling, with the long-term field evaluation. And it will also help us with risk communication and with recalls.

A lot of times when we have field complaints or if we are contemplating a recall, one of the first questions asked is how many units are out there and where are they located at. And it's hard for us to give a hundred percent accurate answer to this.

The only thing that we are requiring from the manufacturer as part of this voluntary registration is they must provide procedures with the units going out in the field and how you are to register the units and the reasons behind why NIOSH is looking for voluntary registration.

This past summer we had an Internet develop an SCSR registration page to see how registration would work here.

We are trying to make it as easy as possible for the users to register since we are making it voluntary. And also we started out with looking at the mining industry initially because they are the single largest civilian deployment of closed-circuit escape respirators in the field.

So basically we have a database with all of the existing MSHA mine IDs, the name of the mine, and their location.

All the mine would have to do initially when they first start to register is to provide who the contact person is, their phone number, their email address, if they have email, or how we could contact them if we need to get to them.

But we are trying to make it as easy as possible. We have pulldown menus for unit type, so all the mine would have to do is click on it. They wouldn't have to type in that it is an Ocenco EBA 6.5 or whatnot. They would have just to click.

Other than that, they would have to enter in the serial number, and then we have pulldown menus for data of manufacture and year.

If the mine is not listed on our database, there's a pulldown menu for add a new mine where they go in and they provide us the information.

And then also with the registration, when you are removing one from the field, we are also asking what's the reason behind why you are moving, or, you know, whether it was -- it reached an expiration date or if there was some kind of damage to it or what.

So that way it would help us keep track of the attrition rates for SCSRs. And also we may see a pattern which may, you know, constitute more research or investigation on our part.

Again, this is just a sample of the spreadsheet that it will provide us. We could do anything with this.

We could group them by, you know, how many M-20s are there out in the field, or we could have how many M-20s are at which mine or, you know, the CSE SR100.

So this program that we use, it was XM. It was free software that we were able to get off of the internet. It will provide us and also MSHA with a lot of useful information, and that's why we are proposing voluntary registration.

And finally, how the new -- or proposed standards will apply to new and previously approved closed-circuit escape respirators.

First, manufacturers and distributors can continue to sell their CCERs that are currently approved for up to three years from the effective date of the new standard.

And finally, closed-circuit escape respirators with current approvals can remain in use for six years after the effective date of the new proposed standard.

That's all we have as a brief overview of the concepts.

If anyone has any comments and questions, we will entertain it now.

MR. KAY: I have got a few, and I will try to be quick.

Can you explain the 30 liter per minute oxygen capacity?

Why do you stop that at 30? Why not something less than 30?

MR. REHAK: Which test is that?

MR. KAY: The capacity test, the Capacity 1 devices, 30 liters of oxygen up to, I believe, 59 liters of oxygen.

If you have a device that had something less than 30 liters of oxygen according to the proposed regulations, it would not be certified.

MR. STEIN: Yeah. At the use rates, I think that came out to something close to 10 minutes, and it really doesn't preclude -- I mean, that's a good area to comment on.

Because when you get down into shorter duration escape devices, there is really no reason why you couldn't. But at some level, it becomes unreasonable.

I mean, certainly we wouldn't want to see that go down to like five liters or something like that because that wouldn't provide, you know, any kind of reasonable escape time, not as conceived anyway.

MR. KAY: I would say that five would be low, but I could see a niche market for maybe a 20 liter device.

MR. STEIN: No argument there.

MR. KAY: I'm not recommending that, but there could be niche markets where that would be the device of choice.

MR. STEIN: Okay.

MR. KAY: The most poplar, the most thoroughly tested CCER in the US today has got a capacity less than 30 liters of oxygen, and it has saved lives. It is effective and safe.

MR. STEIN: Okay. Nothing in there is meant to be provocative in that sense of -- that's a worthwhile comment. I mean, one we receive very well.

MR. KAY: So am I getting that the 30 may be dropped down to some other --

MR. STEIN: Some lower level?

MR. KAY: Something else.

MR. STEIN: Yes. Yes.

It would have to be -- I think what we would have to do, though, too, Mike, if it gets like into where it looks like it's a lower band, it may require rethinking whether the demand rates and so forth still apply.

You know, but I'm thinking what you are saying is that you might want to drop just that one number on Capacity 1 device, perhaps, be one way to look at it.

MR. KAY: Okay. I was just thinking about KO2 units, or chemical units that have got starter oxygen cylinders or a chloride candle, which are known to not function.

Will the capacity tests and will the performance tests on these devices be performed without the use of starter O2 since there is -- historically, they do fail.

MR. STEIN: That's not in the proposal.

I think like to test them differently, if it were designed that way and it had the starter, I would -- it's not currently proposed that they be tested in a mode other than which they were designed to work.

But, of course, regardless of how it's built, regardless of what the oxygen supply is, whether it is chemical, gas, I mean, the same kinds of demand limits would prevail.

So however it was built, it would have to meet that. I don't know. Again, it is something worthy of a comment.

MR. KAY: I'm trying to get my head around the logic in testing a short duration device at almost twice the work rate -- a Capacity 1 device at almost twice the work rate of a Capacity 3 device.

Regardless of the device, the miner, the sailor, whoever is using it is going to make the escape he needs to make.

And he may make that at 1.35 liters per minute, or it may be at 2 and a half. But he's not going to base it on the respirator he has got on.

MR. STEIN: You're right.

The limiting factor in that is how hard a person can work, and they are not -- they are not conscious of that.

It's like how hard can I work if I ask you to go as hard as you can on the treadmill. And then one of the questions you might ask me, Well, for how long because I want to pace myself if you are going to ask me to walk, either way that goes, wanting us to walk on a treadmill really fast.

And I say, You don't have to sustain it all. Just go as hard as you can, and let's see how fast you can make it go.

Now we turn that around and say, now it has to be over ten minutes. You have got to kind of reduce your pace a little bit in order to sustain that.

So the feedback that we get I think from the user community suggests that it needs to be able to keep up with the physiological demand that the person can provide.

MR. KAY: I think the performance test is good challenge for that.

MR. STEIN: Okay.

MR. KAY: My concern is with how it's rated as far as capacity.

By using your logic, an SCBA with a 30-minute cylinder should be tested at a higher work rate than an SCBA with a 60-minute cylinder.

MR. STEIN: On the average, that's true. On the average.

MR. KAY: To gauge capacity.

It's -- I'm applying the same logic to an open-circuit device.

As far as I know, it's unprecedented to test different duration devices at different work rates. A short duration device to be tested at almost twice the workload of a long duration set.

MR. STEIN: It's not really unprecedented because the existing table in Subpart H, that Man Test 4, the average oxygen consumption for like a ten-minute unit is a bit higher than it is --

MR. KAY: It's a bit higher, but it's not almost twice as high.

It's maybe 1 .4 or 5 -- 1.4 as opposed to 1.35.

MR. STEIN: So the general concept --

MR. KAY: I will agree it's a little higher, but it's not approaching the extremes that are proposed here.

MR. STEIN: But the concept is not

unprecedented. Perhaps the values are.

MR. KAY: It's unprecedented from a world view.

I'm not aware of any international standards, any European standards regarding respiratory protection devices that use this concept to test apparatus, to certify apparatus.

MR. STEIN: Indeed, again, worthy of a comment.

MR. KAY: I think I have one other thing.

Just the stressor levels, the CO2 levels, the breathing resistance levels, have all gone up as compared to what's allowed in the current standard, the current part 84.

MR. STEIN: Okay.

MR. KAY: Oxygen can go down to 15 percent for an excursion. That excursion could be 20 minutes into the test so long as it rises to a hundred percent or 80 percent later on in the test, and your average is still over 19 and a half.

So you could have long stretches of test time where you're hovering at 15 percent oxygen, 4 percent CO2, 500 millimeters of water peak to peak.

And is there any data that supports moving in this direction?

MR. STEIN: The higher levels were derived from research done at Penn State. They had looked at work at what kind of, you know, tolerance limits exist. So the excursion values are based upon that work.

Then the average is more based upon like the existing standard. It's more in line with what the current standard is.

So as it is proposed, the concept behind it, or the theory behind it is that the average levels will keep those excursions within bounds.

Now, you know, if you think you have scenarios where you are saying, no, it could still get out of hand, I mean, we would need to examine that and see how reasonable -- is it to expect that those kinds of things could happen.

MR. KAY: And particularly when you get a combination.

A Japanese study done in 1998 breathing 3 percent CO_2 found that the test subjects experienced severe discomfort when they were breathing, I believe, a hundred millimeter water column, so well below what is being proposed here as far as resistance and CO_2.

So I just ask that we all be aware of the physiological stressors that were --

MR. STEIN: Surely. And they are not decoupled in actual use.

As you well know, you can't decouple those because like higher CO_2 and perhaps higher ventilation go hand in hand.

MR. KAY: Right. Thank you.

MR. BOORD: Maybe I can add to that a little bit too.

One of the differences that we are observing here in the concepts that we are discussing, talking about today, is that when we measure these physiological parameters during testing, we are measuring them on a continuous basis.

Under the current paradigm of 42 CFR, you know, we doing the grab samples at periodic points throughout the course of that test.

So those excursions that are between those test points, we don't see today.

MR. KAY: They are lost.

MR. BOORD: So I think, you know, while those excursions that we are conceptualizing may be different than the numbers that you see -- that are present in the tables in 42 CFR, they may actually be even more conservative than what actually happens because of the potential excursions.

So I mean that's a good point, and we should, you know, take it forward for our deliberation.

The other thing I wanted to mention is that relative to the using the physiological demand as a basis for doing and classifying and determining the -- establishing the performance capability of a respirator, that is -- that is a trend that is -- the international standards organization, SE 15, for respiratory protection devices is actually moving in that direction.

And what that standard is actually looking at is a physiological tier that is up to -- I think it's up to six different physiological stress levels.

So while NIOSH has kind of been silent in that regard in the past, I think that that is -- the current technology is going in that direction.

So, again, I think that's a good point that we need to factor into our considerations. And it is one of the trends that we do observe in the industry.

MR. KAY: Thank you.

MR. KOH: Frank Koh, University of Maryland College Park.

I just have a quick, quick question. I really don't know much about mines and stuff, but one likelihood that it floods, I notice that the potassium superoxide interacts exothermically with the water.

Can those units explode? Or are they -- do they have -- in the case that the seal is broken or something like that, do they act vigorously or --

just curious.

MR. STEIN: It could act vigorously, yeah, if you dump that much into water at one time.

But it seems like, you know, a couple of factors work against that.

I mean, in once sense, if you encounter an inundation, the likelihood that anybody would be in near proximity to it is probably pretty low, you know, when you have that much water.

But in order for it to be exposed that quickly, you would have to simultaneously have a breach of the containment.

So, you know, it's kind of an unlikely combination of events. And, you know, the explosion part of it, is certainly something I have never heard of reported, you know, never seen evidence to that severe of a reaction.

MR. KAY: I read in the Kursk incident, the Russian sub that went down, they had KO2 apparatus. It wasn't the water. It was the oily film on top of the water that ignited. One the guys died of CO poisoning because they were involved in the fire because of the KO2 igniting when it hit the oily water.

MR. STEIN: Why did the KO hit the water?

MR. KAY: They had activated the devices and were hanging them up trying to clean up the air because they had high CO2 and low oxygen, and they were trying to get a passive scrubber situation going. And they suspect that the devices were dropped into this oily water and ignited.

They found recovered bodies with third and second degree burns on their backs like they were trying to escape the flames.

MR. STEIN: Duck below?

Again, as you would know, trying to use it that way, I mean, that's kind of like a training issue. I think, too, to explain to people that a use like that is not going to be helpful.

And certainly from the lesson learned there, that it could even prove to be a problem, in particular if you had something like an oil film on the water.

MR. BOORD: I think also, to even add to

that, I think it also demonstrates the need and the importance for the integrity of the packaged unit.

Okay. When we talk about the environmental exposures, the shock, the vibration, the dropping and so on, those are important from the aspect of the mechanical integrity of the system and, you know, that you don't damage one of the components that needs to function.

But it's also important that you don't break it open and expose the internal components to whatever is in the atmosphere, water, oil mist, because these can be potential reactions.

So the packaging and the environmental stresses that it can withstand are important aspects to these closed-circuit -- especially the chemical-based closed-circuit systems.

MR. KOH: Just curious, what pressures can these canisters sustain?

MR. BOORD: That's a good question. That means I don't know.

MR. STEIN: Okay, thank you.

MR. BOORD: Any other questions?

Comments?

Okay. I think what we will do now is maybe take our lunch break. I think we are running a little ahead on the agenda.

But rather than rush through the next presentation, what I think would be best is if we take the lunch break.

And let's allow, let's say, an hour and ten minutes. So if we can resume at -- my watch is still on Eastern time, but I think it is 11:20.

So let's return at 12:30 and continue with the presentations and further discussion.

Thank you.

(A luncheon recess was taken.)

MR. REHAK: I would like to introduce Frank Koh who is from the University of Maryland faculty research assistant, who works with Art Johnson at the University of Maryland.

And Frank is here today to present a piece of work that they have been undertaking and to inform us on that.

Frank.

MR. KOH: Yes. Let me just grab a few more things. Okay. Thank you.

Okay. First of all, I would like to say that I'm very much humbled by some of the experts in here, and I hope that the presentation goes smoothly.

And I want to firstly apologize for wearing white socks in case you guys noticed. My luggage got lost, and so that's the excuse. I'm holding to that one.

Tim was over there saying, You wore white socks. So I had to make sure, the color of my socks. There is an excuse. My luggage got lost.

Let me go ahead and start with the presentation.

In our lab, we normally test individuals with respirators, and we are trying to figure out what kind of effects that has on the human person wearing the respirator.

And about two years ago, a question came up: I wonder how long -- not the length of time, but what the distance an individual can walk wearing one or those CSE SR100 units.

So that was one question that we asked.

The other one was, What would happen if the individual was to work at a rate that's a lot higher than self-paced rate.

So those are the two questions that arised about two years ago.

So let's start with the PowerPoint. So, as all of you guys already know, the self-rescuers provide about 60 minutes of oxygen. I think the SR100s themselves produce about a hundred liters of oxygen.

And as all of this -- the chemical reactions have been already talked about. I just want to say that the chemical reaction itself is an exothermic reaction, and it produces a lot of water molecules. So we will talk a lot more about that later on.

And, as you can imagine, as it was stated many, many times already, the SCSRs work best when you work at a rate -- or you work at a rate where the oxygen demand equals oxygen supplied by the units themselves.

So what happens at high work rate? You can imagine that the air you breathe in would be disproportionally wasted into the atmosphere, and the units probably will not last as long.

And the other question that you want to find out was how long a distance can an individual walk while wearing one of these rescuers.

On the average, what we found was about 3.7 miles.

Let me just go ahead into the next slide. And the other question, again, was at high work rate, what would happen.

So I go will go ahead and discuss this at a later slide, but you can imagine your performance time drops tremendously.

Again, I think this has been said before, so I will skip to the next one.

So we have a total of 14 volunteers, hesitant volunteers, I might add, from the University of Maryland student body.

And they were given health assessment

tests to make sure that they are able to test in our lab and not just have some trouble.

And each of the individuals' maximum oxygen consumption was roughly in the range of 2.7 to 3.3 liters per minute.

This was basically a treadmill test. The individual was required to walk initially at 3 miles per hour at zero percent grade, and they were allowed to adjust the speed accordingly. And they were asked to basically walk as long as they can.

Here's an example of one subject, and there's a little picture of the SR100.

So on the distance side, some individuals were able to walk as long as 5.7 miles, and some were only able to walk 1.3 miles.

I'll go into more of the details a little later. So on the average, it was 3.7 miles.

The times ranged, again, as well. Some were able to walk for 94 minutes at their own pace, and there was one individual who actually could only walk for 30 minutes.

So looking at this chart, this is just a quick summary of all of the individuals' time and distance.

Looking at that subject who ran 30 minutes for a distance of -- not ran. I should say walk. I apologize -- walk for 30 minutes for a distance of 1.3 miles, you can see -- we wanted to see what would happen if that person was given the opportunity to retest.

So what we found was that that person was actually able to increase their distance and walk for a total of 48 minutes. The distance, I think, was 2.3 miles. They were able to increase up to 2.3 miles.

In that regards, it kind of shows you that a slight training effect might be a part of this thing.

So we go to the next slide.

So, let's see. Contrary to popular belief, we found that there was no correlation to the individual's weight and speed. And there was no correlation between speed and distance. And there was no correlation between the weight and distance as well.

This is just a quick bar graph of a time frame of an individual who ran about 68 minutes.

You can see initially the treadmill starts at 3, and that they hike it up to about 3.5. And then, as you can see, as the SEA unit themselves starts becoming harder to breathe, they slow down their own pace.

Here's another example of another person who walked for about 69 minutes. Again, you can see that they were able to slow down their speed to adjust for how much oxygen was being produced by the unit.

So here are some of the major complaints that we got from the SR100s.

As we talked about before, it's an exothermic thermic reaction, so the units themselves get very, very hot.

The individuals -- actually, we have to have them wear a towel, or put a towel in front of the subject because the units were so hot that it was burning some of the subjects.

And a lot of the inhaled air was very, very hot and humid. And so some of those subjects couldn't tolerate that at all.

Additionally, people complained of inhaling a gritty material, and there is also a high resistance towards the end of testing.

And especially what we found was that those noseclips are not so good for individuals who have small noses. We had some individuals of Asian decent in that, and those kept sliding right out.

And the mouthpiece is very, very uncomfortable. You can imagine with that mouthpiece in your mouth, you can't swallow your own saliva, so you can just imagine yourself drooling all the way down the tube. That's one of the number one complaints.

The other thing is that the mouthpieces themselves sort of dug into the gums of the individuals. That was a major problem for a lot of the subjects.

So in conclusion, as things were already implemented in this regards, the SCSRs should be stationed at specific locations so that it allows an individual to escape a dangerous situation.

And perhaps additional self-rescuers is available at the beginning of an escape situation.

So, let's see. In general, as we saw with that one individual, training is very, very important. And knowing some of the limitations as well as all of the complaints may help that individual be more comfortable.

And, as we found out from our own subjects, just being familiar with the unit would also increase usage time of the unit.

So the next study that we did was to determine how an individual would be affected if the speed was not controlled.

So they were forced to work at a higher work rate.

We had one volunteer for this, and this is her maximum oxygen consumption at three liters per minute. And she was forced to walk at a speed to solicit 65, 70, 75, 80, and 85 percent of her maximum oxygen consumption.

She was also instructed to try to go as long as she can.

So as you might imagine, the performance time decreased linearly as oxygen consumption increased, and none of the performance times reached 60 minutes.

And at all of the workloads that we did, the SCSRs was not able to supply enough oxygen for that person. So the main reason for termination was not enough oxygen.

Here you can see the inverse relationship of performance time to workload. And the rating of perceived exertion is a scale from zero to 20, 20 being very, very, very hard to zero being pretty comfortable. And those are the rating perceived exertion of a person walking for six minutes into an exerciser.

So you can see that they started at 13, and then at 20, at termination, they pretty much say, Hey, I can't do this. This is too hard for me.

The breathing apparatus comfort scale, a scale from zero to five, zero meaning this is terrible. I can't wear it anymore. And five is pretty comfortable.

So you can see, again, in six minutes in, they felt it was pretty comfortable. And then near the termination, they felt that it was very, very uncomfortable.

So in order to test what would happen if there was no self-rescuer, what would happen, we actually used the Kamon formula to derive what kind of penalties would occur.

So from this equation, we were able to derive this equation here. That's the penalty that you would suffer from wearing the SR100.

So the individual, that curve -- I think the slope is pretty much the same, but the pink dots, that's the formula that we used to extrapolate that. So essentially the shift is the penalty that we pay for wearing the SR100.

So in respect to discussion, if you panic, your work rate increases.

And, again, if you work at a higher rate than you are supposed to, you may feel very uncomfortable with the unit really, really quickly. And there will be less oxygen for you to use, so performance time will decrease really, really quickly.

So essentially the units should be used at low rates.

So in conclusion, there is an inverse relationship between performance time and exercise intensity, and this pretty much confirms the fact that the SR100's must be used at low intensity and -- or else you will pay a large penalty.

So overall, in the emergency situation, you should not panic. And the SR100s themselves should be operated at a low work rate.

As we saw, we saw one subject. There is definitely a training effect. An individual who has worn the SR100 will likely be able to walk for a longer duration than a person who has just tried it for the first time.

And as -- I guess this aspect is already implemented. The SR100 should be located on specific routes of escape and perhaps extra SR100s should be available for escape at the beginning of escape.

Okay. So with that, I guess questions.

Did I go too quickly? Wow, people are still awake. That's incredible.

MR. BUBAN: When you said that you had a disproportional amount of oxygen available to you or the performance of the unit goes down when work is being done, does that mean that in training situations, the guys will be told not to try to implement their own self-rescue?

MR. KOH: No. I think basically if you are working at a high rate, a lot of the air that you breathe in is not being used. So when you exhale, you are expelling air that could have possibly been used during that time to rebreathe.

So that's one of the primary reasons why you have to control your breathing?

MR. BUBAN: The extra exhale goes out. It doesn't come back in the --

MR. KOH: Right. It doesn't come back, and that's one of the reasons why the oxygen would be just released into the atmosphere.

MR. BUBAN: Your recommendations for the 100 size unit, that it be carried with them and then larger backs be dispersed, or the same size unit be everywhere?

MR. KOH: I guess that depends on the situation in the mine. I haven't really been given that much thought about it. But as long as, you know, the -- I guess it depends on the mine again. They should consider that aspect, that during the shift, they should have enough in there so that an individual can walk out.

The question that arises is would you want to set those up so that the person who would not be able to make it can make it, or do you just use the average?

Well, that all depends on how much do you value the human life. That's something that I guess in the industry you have to consider.

MR. KOVAC: Frank, point of note. When you run the numbers on your graphs, I think you project like a 12 to 13 percent penalty.

You illustrious predecessor, Dr. Kamon, doing the same sort of things, projected a 15 percent penalty.

So you did do your numbers right.

MR. KOH: The question is, did I do the numbers right?

MR. KOVAC: No. I'm just saying that you did.

You have confirmation. The only difference being that they did in-mine studies where you would expect broken terrain, other factors to play versus running in a laboratory on a treadmill in comfortable shoes and all of that.

MR. KOH: I see. So thank you.

MR. KOVAC: So there you go. There was some benefit.

MR. KOH: Yes, definitely.

Any other questions?

All right. Yay.

MR. BOORD: Okay. Thank you, Frank. That was very good.

At this point on the agenda, we would open it up to any other comments, questions, or any other speakers who want to address the audience, if there are any.

Okay. I think that brings us to our wrap up.

And, again, what I want to stress is that we have had considerable discussion today concerning the concepts that we are developing for closed-circuit escape systems, and these concepts are presented for discussion purposes and do not represent any final determination or policy of the Agency.

We are continuing on our work to develop a proposed rule, and we are doing that in consultation with the Mine Safety and Health Administration.

In order to facilitate the discussions and interact with our stakeholders, we are conducting the two public meetings. The first one was last week, September 19, in Arlington, Virginia. And this meeting today, September 28, concludes the two public meetings that we had to present the concepts and to discuss them.

The docket that we have established will remain open until November 1.

And in support of a comment that we had a little earlier in the day from one of the participants concerning the timing of November 1 and the release of the long-term field evaluation Phase 8 and 9 reports, the November 1 date may change.

We may hold it open longer in order to facilitate total review of those reports when they are issued.

And we will announce that on our website. So if you look to the NIOSH, NPPTL website and the concept for closed-circuit escape respirators, that date will be confirmed.

Again, the contact information for the docket is the address that's on the screen, and it's also in the handout that was provided with the registration package.

In order to arrange a one-on-one discussion with the team to discuss any of the concepts that we have raised today and to bring up new ideas, you can do that by contacting Tim at the phone number or email address identified, and that is also in the information packet.

And with that, unless anybody has a comment, a question, or a statement that they want to address to the audience, I think we are complete.

Thank you for attending.

(Whereupon, the proceedings in the above-captioned matter were concluded at 1:00 p.m.)

CERTIFICATE OF REPORTER

I, Joseph A. Inabnet, do hereby certify that the transcript of the foregoing proceedings was taken by me in Stenotype and thereafter reduced to typewriting under my supervision; that said transcript is a true record of the proceedings; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and further, that I am not a relative or employee of any attorney or counsel employed by the parties thereto, nor financially or otherwise interested in the outcome of the action.

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Joseph A. Inabnet

Court Reporter